

A comprehensive literature review of the applications of AI techniques through the lifecycle of industrial equipment

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Abstract

Driven by the ongoing migration towards Industry 4.0, the increasing adoption of artificial intelligence (AI) has empowered smart manufacturing and digital transformation. AI enhances the migration towards industry 4.0 through AI-based decision-making by analyzing real-time data to optimize different processes such as production planning, predictive maintenance, quality control etc., thus guaranteeing reduced costs, high precision, efficiency and accuracy. This paper explores AI-driven smart manufacturing, revolutionizing traditional approaches and unlocking new possibilities throughout the major phases of the industrial equipment lifecycle. Through a comprehensive review, we delve into a wide range of AI techniques employed to tackle challenges such as optimizing process control, machining parameters, facilitating decision-making, and elevating maintenance strategies within the major phases of an industrial equipment lifecycle. These phases encompass design, manufacturing, maintenance, and recycling/retrofitting. As reported in the 2022 McKinsey Global Survey (<https://www.mckinsey.com/capabilities/quantumblack/our-insights/the-state-of-ai-in-2022-and-a-half-decade-in-review>), the adoption of AI has witnessed more than a two-fold increase since 2017. This has contributed to an increase in AI research within the last six years. Therefore, from a meticulous search of relevant electronic databases, we carefully selected and synthesized 42 articles spanning from 01 January 2017 to 20 May 2023 to highlight and review the most recent research, adhering to specific inclusion and exclusion criteria, and shedding light on the latest trends and popular AI techniques adopted by researchers. This includes AI techniques such as Convolutional Neural Networks (CNN), Generative Adversarial Networks (GAN), Bayesian Networks, Support Vector Machines (SVM) etc., which are extensively discussed in this paper. Additionally, we provide insights into the advantages (e.g., enhanced decision making) and challenges (e.g., AI integration with legacy systems due to technical complexities and compatibilities) of integrating AI across the major stages of industrial equipment operations. Strategically implementing AI techniques in each phase enables industries to achieve enhanced productivity, improved product quality, cost-effectiveness, and sustainability. This exploration of the potential of AI in smart manufacturing fosters agile and resilient processes, keeping industries at the forefront of technological advancements and harnessing the full potential of AI-driven solutions to improve manufacturing processes and products.